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B.Tech Even Semester (CBCS) Exam., May—2018

AGRICULTURAL ENGINEERING

(4th Semester)

Course No. : AE–403 (C)

(Kinematics and Dynamics of Machines)

Full Marks : 75

Pass Marks : 30

Time : 3 hours

Note :
1. Attempt **one** question from each Unit.
2. Begin each answer in a new page.
3. Answer parts of a question at a place.
4. Assume reasonable data wherever required.
5. The figures in the right margin indicate full marks for the questions.

UNIT—I

1. *(a)* Define the following : 9

(i) Kinematic pair

(ii) Kinematic chain

(iii) Mechanism

(iv) Structure

(v) Inversions

(vi) Degrees of freedom

(b) Explain the inversions of a four-bar mechanism. 6

2. *(a)* State Grubler's criterion for the degrees of freedom. Determine the degrees of freedom of the mechanisms shown in Fig. 1 : 6

(i) *(ii)*

Fig. 1

(b) Indicate the type of four-bar mechanism shown in Fig. 2 : 9

(i) *(ii)* *(iii)*

Fig. 2

UNIT—II

3. *(a)* What is transmission angle? Determine the maximum and minimum transmission angles of the mechanisms shown in Fig. 2. 9

(b) Distinguish between toggle and locking of a four-bar mechanism. 6

4. *(a)* Explain with a neat sketch crank and slotted lever quick return motion mechanisms. 6

(b) Write the differences between the following with examples : 9

(i) Lower pair and Higher pair

(ii) Sliding pair and Turning pair

(iii) Class–I mechanism and Class–II mechanism

UNIT—III

5. *(a)* What is relative velocity? In a slider-crank mechanism, the crank is 480 mm long and rotates at 20 rad/s in the counter-clockwise direction. The length of connecting rod is 1·6 m. When the crank turns 60° from the inner dead-centre, determine—

(i) the velocity of the slider;

(ii) the position and velocity of a point on the connecting rod having the least absolute velocity;

(iii) the angular velocity of connecting rod. 9

(b) Define the following : 6

(i) Absolute velocity

(ii) Kinematics

(iii) Kinetics

(iv) Dynamics

6. *(a)* What is instantaneous centre? Write the rules to locate the instantaneous centres. State angular velocity ratio. 6

(b) In a four-bar mechanism, the crank *AB* rotates at 36 rad/s. The lengths of the links are *AB* 200 mm, *BC* 400 mm, *CD* 450 mm and *AD* 600 mm. *AD* is the fixed link. At the instant when *AB* is at right angle to *AD*, determine the velocity of *(i)* mid-point of the link *BC* and *(ii)* a point on link *CD*, 100 mm from the pin connecting the links *CD* and *AD*. 9

UNIT—IV

7. *(a)* Derive the expression for the velocity and acceleration of the piston and connecting rod of a reciprocating engine. 9

(b) If the crank and connecting rod are 50 mm and 100 mm long respectively and the crank rotates at a constant speed of 2500 rpm, determine the crank angle at which the maximum velocity occurs and the maximum velocity of the piston. 6

8. *(a)* What is epicyclic gear train? How do you get various speeds from an epicyclic gear train? 9

(b) An epicyclic gear train consists of 3 gears *A*, *B* and *C*. The gear *A* has 80 internal teeth. The gear *C* has 36 external teeth. The gear *B* meshes with gears *A* and *C*, and it is carried on an arm which rotates about the centre of *A* at 50 rpm. If the gear *A* is fixed, determine the speed of gears *B* and *C*. 6

UNIT—V

9. *(a)* What is the need of clutch in a vehicle? Explain the working of a single-plate clutch. 9

(b) A single-plate clutch is required to transmit 8 kW at 1000 rpm. The axial pressure is limited to 70 kN/m^2. The mean radius of the plate is 4·5 times the radial width of the friction surface.

If both sides of the plate are effective and coefficient of friction is 0·25, then find *(i)* the inner and outer radii of the plate and mean radius, and *(ii)* the width of friction lining. 6

10. *(a)* Derive the expression for the determination of the torque transmitted through the clutch. 9

(b) Why is multiplate clutch preferred in present-day vehicles? A multiplate clutch transmits 80 kW of power at 2400 rpm. Coefficient of friction for the friction surfaces is 0·1. Axial intensity of pressure is not to exceed 200 kN/m^2. The internal radius is 75 mm and is 0·6 times the external radius. Find the number of plates needed to transmit the required power. 6

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